

## REMARKS

Claims 1-5 are pending in the application. Claims 1, 3, and 5 are independent. By the foregoing Amendment, claim 3 has been amended and claims 4-5 have been added. These changes are believed to introduce no new matter and their entry is respectfully requested.

### Rejection of Claim 1 Under 35 U.S.C. §103(a)

In the Office Action, the Examiner rejected claim 1 under 35 U.S.C. §103(a) as being obvious over “Microstructure investigation of plasma sprayed HA/Ti6Al4V composites by TEM” by Khor et al., Materials Science & Engineering A281 (2000) 221–228, (hereinafter “*Khor I*”), in view of “Plasma spray synthesis of nanomaerial powders and deposits” by Karthikeyan et al., Materials Science & Engineering A238 (1997) 275–286 (hereinafter “*Karthikeyan*”). Applicants respectfully traverse the rejection.

To establish a *prima facie* case of obviousness, the Examiner must show that the cited references teach each and every element of the claimed invention. (MPEP §2143.) *citing In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)). A patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was independently known in the prior art. *KSR Int’l C. v. Teleflex, Inc.*, No 04-1350 (U.S. Apr. 30, 2007). If a combination or modification to a reference is used, an Examiner must show that there is some expectation of success that the combination or modification proffered would predictably result in the claimed invention. Obviousness is a question of law based on underlying factual inquiries. The factual inquiries enunciated by the U.S. Supreme Court in *KSR* include the *Graham* factors of determining the scope and content of the prior art, ascertaining the differences between the claimed invention and the prior art, and resolving the level of ordinary skill in the pertinent art.

Once the *Graham* factual inquiries are resolved, the Examiner must explain why the difference(s) between the cited references and the claimed invention would have been obvious to one of ordinary skill in the art. The rationale used must be a permissible rationale. The USPTO promulgated Examination Guidelines for Determining Obviousness in View of *KSR* in the

Federal Register, Vol. 72, No. 195 (October 10, 2007). These *KSR* Guidelines enumerate permissible rationales and the findings of fact that must be made under the particular rationale.

One such rationale is termed “Combining Prior Art Elements.” This appears to be the basis for the Examiner’s rejection of claim 1. According to the Examination Guidelines, to use the “Combining Prior Art Elements” rationale as a basis for rejecting claims, an Examiner must articulate four things: (1) a finding that the prior art included each element claimed, although not necessarily in a single prior art reference, with the only difference being the lack of actual combination of the elements in a single reference; (2) a finding that one of ordinary skill could have combined the elements as claimed by known methods, and that in combination, each element merely would have performed the same function as it did separately; (3) a finding that one of ordinary skill would have recognized that the results of the combination were predictable; and (4) any additional findings based on the *Graham* factual inquiries to explain the conclusion of obviousness. If any of these findings cannot be made, then this rationale cannot be used to support a conclusion of obviousness. The Court in *KSR* noted that combining known prior art elements is not sufficient to render the claimed invention obvious if the results would not have been predictable.

Applicants respectfully submit that the Examiner has failed to find that *Khor I* in view of *Karthikeyan* include each element in claim 1. Claim 1 recites:

A method of producing nano-composite powder ***consisting essentially of*** hydroxyapatite (HA) and zirconium oxide (ZrO<sub>2</sub>) comprising the steps of: reacting orthophosphoric acid with calcium hydroxide to form a HA suspension; adding zirconium suspension to the HA suspension to form a composite feedstock; subjecting the composite feedstock to ***Radio Frequency (RF) Plasma Spraying*** to form the nano-composite powder. (Emphasis added.)

In the Office Action, the Examiner states that *Khor I* teaches a method for producing HA materials with improved mechanical properties by the inclusion of a reinforcing material to form a composite. The Examiner states that zirconia and titanium are taught as good candidates for

use as the reinforcing phase. The Examiner states further that *Khor I* used a wet reaction method utilizing calcium hydroxide and orthophosphoric acid to produce the HA raw material, which was then dried and used in a powder plasma spraying process to produce composite HA/titanium (Ti6Al4V) material. The Examiner determines that the process in *Khor I* differs from claim 1 because the HA solution is dried before being subjected to the plasma spraying process and Ti6Al4V is used as a reinforcing phase, but concludes that it would be obvious to add a zirconia suspension to the HA suspension instead of Ti6Al4V as the reinforcing phase due to its disclosure by *Khor I* as a good candidate. Applicants respectfully disagree.

In the Office Action, the Examiner states further that *Karthikeyan* teaches a process for producing nanocomposite powders through the plasma spraying of liquid precursor solutions. A zirconia powder was produced through this method with particle sizes in the range of 20-80 nanometers using a liquid feedstock solution. The Examiner then concludes that it would be obvious to combine the method taught by *Khor I* of producing a liquid HA solution from orthophosphoric acid and calcium hydroxide with the liquid precursor plasma spraying process taught by *Karthikeyan*. One would be motivated to do so to eliminate the need to produce an HA powder for use in the plasma spraying step, thereby simplifying the production process. Applicants respectfully disagree.

Applicants respectfully submit that the Examiner has failed to show how the combination of *Khor I* in view of *Karthikeyan* teaches a “method of producing nano-composite powder ***consisting essentially of*** hydroxyapatite (HA) and zirconium oxide (ZrO<sub>2</sub>)” as recited in claim 1.

*Khor I* appears to disclose a composite coating of hydroxyapatite and titanium (Ti6Al4V) formed by plasma spraying. The Examiner appears to be correct that *Khor I* discloses that “zirconia, titanium (Ti6Al4V), Ni<sub>3</sub>Al and Al<sub>2</sub>O<sub>3</sub> have been considered as good candidates for the reinforcing phases.” However, *Khor I* merely refers to publications by others (references 12-14) for this teaching and itself ***does not enable using zirconia as a reinforcing phase***. Of these references, only reference 12 (Chang et al., Journal of Materials Science: Materials in Medicine 8 (1997) 193-200) (hereinafter “*Chang*”) relates to a composite that includes zirconia and hydroxyapatite.

References 13 and 14 cited in *Khor I* relate to a composition of hydroxyapatite and titanium, and a composition of hydroxyapatite and  $\text{Ni}_3\text{Al}$  and  $\text{Al}_2\text{O}_3$ , respectively. *Chang* however teaches that because the bonding strength between hydroxyapatite and substrate is poor *Chang* uses zirconia that is stabilized with  $\text{Y}_2\text{O}_3$ . The composite materials obtained by *Chang* thus contain  $\text{Y}_2\text{O}_3$  whereas claim 1 of the present application defines a nanocomposite powder **consisting essentially of** hydroxyapatite and zirconium oxide. Applicants respectfully submit that *Karthikeyan* cannot make up for this deficiency because the  $\text{Y}_2\text{O}_3$  of *Khor I* already exists. Applicants therefore respectfully submit that *Khor I* in view of *Karthikeyan* fails to teach “method of producing nano-composite powder **consisting essentially of** hydroxyapatite (HA) and zirconium oxide ( $\text{ZrO}_2$ )” as recited in claim 1.

Applicants also respectfully submit that *Khor I* in view of *Karthikeyan* fails to teach “subjecting the composite feedstock to **Radio Frequency (RF) Plasma Spraying** to form the nano-composite powder” as recited in claim 1. The Examiner appears to concede this point in the failure to point to any specific teaching in any of the references cited of RF plasma spraying. The Examiner appears to argue that the plasma spraying disclosed in *Khor I* and *Karthikeyan* reads on the Radio Frequency (RF) Plasma Spraying recited in claim 1. Applicants respectfully disagree.

*Khor I* appears to use a **conventional plasma spraying** process, i.e., a process where a direct current (DC) electric arc is used to generate a stream of high temperature ionised plasma gas. This fact can for example be taken from table 1 on top of page 222, which shows operation parameters that are typical for a DC plasma system and include a Gun current as a direct current, i.e., a DC system. The most striking differences in process parameters are also summarized on the website of the Center for the Plasma Processing of Materials, a printout of which is attached hereto. The instrument used in *Khor I*, Miller Thermal 4500 (see below table 1 of *Khor I*), is generally used in conjunction with DC plasmas (see, e.g., US 6,004,362, col. 4, line 53 et seq.). In contrast thereto, claim 1 of the present application defines Radio Frequency Plasma Spraying as the plasma spraying process, by which the nano-composite powder is formed in the method of the present invention. We would therefore suggest submitting that this plasma spraying process

provides a substantial and unexpected difference that affects the powder formed, as explained in the following.

Applicants also respectfully submit that the Examiner has failed to find that one of ordinary skill would have recognized that *Khor I* in view of *Karthikeyan* would have predictably resulted in claim 1. The method of embodiments of the present invention, which is based on a Radio Frequency (RF) Plasma Spraying Process, allows for the formation of a product with a unique nanoparticle microstructure not attainable with DC plasma spraying techniques. This unexpected finding may be explained by the fact that DC plasma spraying is a melting or semi-molten coating process whereas the RF plasma process is a vaporization and condensation powder processing method (see also paragraph [0030] of the specification of the present application). Therefore the RF Plasma Spraying Process has finer control on particle size, microstructure and morphology as indicated in, e.g., Fig. 1 to Fig. 3 and explained, e.g., in paragraphs [0022] to [0030] of the specification of the present application.

Additionally, as described in paragraph [0032] and illustrated in Table 3 of the description of the present application, the particles obtained using the method of the claimed invention show advantageous mechanical properties when compared to conventionally obtained powders. The product of the method of the invention is superior to conventional powders in terms of the Young's modulus, which is also known as the modulus of elasticity or the tensile modulus and indicates the elastic properties of a solid undergoing tension or compression in only one direction (see the attached extract of the Encyclopædia Britannica, 2001, Deluxe CD-edition). Furthermore, the product of the method of the claimed invention may also be superior to conventional powders in terms of fracture toughness and hardness (Table 3 & paragraph [0032] of the description).

Applicants respectfully submit further that there are substantial differences between the RF Plasma Spraying Process of the claimed invention and the DC plasma spraying process in terms of spray characteristics, the reaction chamber and the collection techniques. Regarding the spray characteristics the RF process uses a comparatively low temperature, a diffused flame, a lower speed, longer dwell time, and axial powder or liquid injection. With regard to the reaction

chamber the RF process uses a larger heating chamber and reactive gases (O<sub>2</sub>, N<sub>2</sub> etc.) chamber. As for the collection techniques the RF process uses metal filters, which are advantageous for powder (nano) production when compared to the DC process. None of the cited references provides any indications in this regard or suggests or directs the skilled artisan to contemplate attempting modifying these characteristics.

Applicants respectfully submit further that *Khor I* concerns the formation of a mixture of two phases, namely hydroxyapatite and titanium. This can, for example, be taken from Figures 4, 7 and 12 of *Khor I*. This effect is due to temperature profiles and processing times of the DC plasma process, which only allow for the formation of physically mixed powders. In contrast thereto, the present inventors observed that the RF plasma (T~6000-8000 °C) processing route with its large plasma volume produces *chemically* nano-alloyed nano-composite particles of hydroxyapatite and zirconia rather than physically mixed coatings, as indicated in paragraph [0029], 7<sup>th</sup> line of the specification.

Using the method of the claimed invention a product is formed that has no clear interface between hydroxyapatite and zirconia phases, as depicted in, e.g., Fig. 2 of the present application. Rather, the particles/ powders incorporate the secondary additions (ZrO<sub>2</sub>) within the matrix of hydroxyapatite, as pointed out in paragraphs [0025] to [0028] and recited in paragraph 33, 2<sup>nd</sup> sentence (lines 5 & 6) of the specification of the present application. In fact, the interface of the two materials is intimately graded as has been shown by extensive X-ray diffraction, crystallographic computing and differential scanning calorimetry work (see also Kumar et al., *Acta Materialia* (2004) 52, 1171-1181, attached hereto). This grading appears as ZrO<sub>2</sub>-CaZrO<sub>3</sub>-calcium phosphate-HA, making this a signature nano-composite powder material. As a result the chemical continuum of the particles is preserved. Kumar et al. (supra), which has been published after the priority date of the present application, also illustrates the possibility of forming separate nanophases using the RF plasma spraying. It shows that both hydroxyapatite, which is crystalline and amorphous calcium phosphate, which is non-crystalline, can coexist due to the fast cooling rate of the RF process. There is neither a suggestion nor a motivation for a respective contemplation in *Khor I* that such effects could be achieved and/or no predictability. The subject matter of claim 1 can thus not be obvious in view of *Khor I*.

Applicants respectfully submit further that due to the properties (mainly a miscibility gap) inherent in hydroxyapatite and zirconia this “nano-alloying” cannot be achieved through other types of spraying of solid or liquid precursors or through equilibrium processing, i.e., conventional heat treatment. In DC plasma spraying used in *Khor I* resident times in the plasma are very low thus only allowing a physical mixing to occur. The RF plasma is conceptually different and superior to other thermal plasmas in this respect as it is firstly a relatively low temperature process, while DC plasmas are of about 15-25,000°C. The RF plasma of the claimed invention further introduces a larger volume plasma, enables relatively higher resident time and allows for a more wholesome treatment of the injected particles, while allowing easy mixing of the feedstock.

Applicants respectfully submit that *Karhikeyan* does not make up for the deficiencies in *Khor I*. *Karhikeyan* appears to be directed to disclose the formation of fine particles of either alumina, zirconia or yttria stabilized zirconia. Similar to *Khor I*, conventional plasma spraying is used in *Karhikeyan* (abstract, first phrase) rather than RF Plasma Spraying. The DC plasma spraying process is modified in *Karhikeyan* by omitting a reaction chamber (page 275, right col., second paragraph, first sentence of *Karhikeyan*) and termed plasma spray synthesis. This process is clearly distinguished from RF plasma spraying on the same page of *Karhikeyan* (left col., first paragraph, lines 8 to 14).

Further, Fig. 1 of *Karhikeyan* (top of page 276 thereof) is a schematic depicting an anode and a cathode, which is typical for a DC plasma system. An RF system, being an induction-coupled plasma, does not have electrodes. In this regard, the plasma spray torch used in *Karhikeyan* is a Miller Thermal SG 100 (page 276, right col., last line), which is a DC plasma torch. This fact can be taken from the attached manufacturer’s brochure (see, e.g., the figure at the bottom of page 7 under “Model SG-100 Gun” or the legend on the bottom of page 9 under “Net Energy”). Likewise, the operation parameters depicted in table 1 on page 278 of *Karhikeyan* include values of an Arc current (A) and voltage (V) of a direct current, thereby indicating a DC plasma spraying system. In addition, *Karhikeyan* does not suggest to the skilled

reader to use an RF Plasma Spraying Process, neither does it motivate him to attempt doing so. Accordingly, combining *Khor I* and *Karhikeyan* cannot render the method of claim 1 obvious.

Because the Examiner has failed to find that *Khor I* in view of *Karhikeyan* include each element in claim 1, and because the Examiner has failed to find that one of ordinary skill would have recognized that *Khor I* in view of *Karhikeyan* would have predictably resulted in claim 1, Applicants respectfully submit that the combination of *Khor I* in view of *Karhikeyan* does not render claim 1 obvious. Accordingly, Applicants respectfully submit that claim 1 is patentable over the combination of *Khor I* in view of *Karhikeyan* and request that the Examiner reconsider and remove the rejection to claim 1.

#### Rejection of Claims 2-3 Under 35 U.S.C. §103(a)

In the Office Action, the Examiner rejected claims 2-3 under 35 U.S.C. §103(a) as being obvious over *Khor I* in view of *Karhikeyan* as applied to claim 1 and in further view of “Microstructure investigation of plasma sprayed HA/Ti6Al4V composites by TEM” by Khor et al., Materials Science & Engineering A276 (2000) 160–166 (hereinafter “*Khor II*”). Applicants respectfully traverse the rejection.

Claim 2 properly depends from claim 1 and is thus patentable for at least the same reasons that claim 1 is patentable. (MPEP §2143.03 (citing *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988)). Accordingly, Applicants respectfully request that the Examiner reconsider and remove the rejection to claim 2.

Applicants respectfully submit that the Examiner has failed to find that *Khor I* in view of *Karhikeyan* in further view of *Khor II* include each element in claim 3. Applicants also respectfully submit that the Examiner has failed to find that one of ordinary skill would have recognized that *Khor I* in view of *Karhikeyan* in further view of *Khor II* would have predictably resulted in claim 3.



Claim 3 recites:

“A nano-composite powder comprising: 60-90 wt % calcium hydroxyapatite; 10-40 wt % zirconium oxide; and traces of calcium phosphate, *wherein the nano-composite powder comprises alloyed nano-sized particles, the alloyed nano-sized particles comprising calcium hydroxyapatite, calcium phosphate and zirconium oxide.*” (Emphasis added.)

In the Office Action, the Examiner concedes that *Khor I* in view of *Karthikeyan* are silent as to the composition of a nano-composite powder containing 60-90% HA, 10-40% wt.% ZrO<sub>2</sub>, and traces of calcium phosphate. It appears that the Examiner is asserting that *Khor II* teaches plasma spraying precursor solutions of HA including 10 and 30 wt.% ZrO<sub>2</sub>, and that composite powders consisting of 90 wt.% HA and 10 wt.% ZrO<sub>2</sub> and 70 wt.% HA and 30 wt.% ZrO<sub>2</sub> can be produced. The Examiner then determines that it would be obvious to one skilled in the art that trace amounts of calcium phosphate would exist in the composite. The Examiner then concludes that it would be obvious to “make such modification in the routine experimental pursuit of improved material performance.” Applicants respectfully disagree.

Applicants respectfully submit that a person of ordinary skill would not have predicted that combining *Khor I* with *Karthikeyan* and *Khor II* would have resulted in the claimed invention. That is, there is ***no predictability of results***. For example, in embodiments of the claimed invention a Radio Frequency (RF) Plasma Spraying Process allows for the formation of a product with a unique nanoparticle microstructure not attainable with DC plasma spraying techniques used in *Khor I*, *Karthikeyan*, and *Khor II*. One unexpected finding may be explained by the fact that DC plasma spraying is a melting or semi-molten coating process, whereas the RF plasma process is a vaporization and condensation powder processing method (*see* paragraph [0030] of Applicants’ Specification). Thus, *Khor I* in view of *Karthikeyan* in further view of *Khor II* operate completely differently from the claimed invention. Accordingly, one of ordinary skill would not have recognized that the results of using the conventional plasma spraying process of *Khor I*, *Karthikeyan*, and *Khor II* would predictably result in the claimed invention.

Applicants respectfully submit that *Khor I*, *Karthikeyan*, and *Khor II* are further distinguished from the claimed invention. For example, *Khor I* appears to be directed to the formation of a mixture of two phases, namely hydroxyapatite and titanium. This can, for example, be taken from Figures 4, 7 and 12 of *Khor I*. This effect is due to temperature profiles and processing times of the DC plasma process of *Khor I*, which only allow for the formation of *physically* mixed powders.

In fact, the interface of the two materials is intimately graded as has been shown by extensive X-ray diffraction, crystallographic computing and differential scanning calorimetry work (see also Kumar et al., *Acta Materialia* (2004) 52, 1171-1181, submitted herewith in an IDS (hereinafter “Kumar”). The grading appears as  $\text{ZrO}_2\text{-CaZrO}_3\text{-calcium phosphate-HA}$ , making this a signature nano-composite powder material. As a result, the chemical continuum of the particles is preserved. *Kumar*, which has been published after the priority date of the present application, also illustrates the possibility of forming separate nanophases using the RF plasma spraying of the claimed invention. It shows that both hydroxyapatite, which is crystalline and amorphous calcium phosphate, which is non-crystalline, can coexist due to the fast cooling rate of the RF process. Applicants respectfully submit that a person of ordinary skill in the relevant art would not have predicted that such effects could be achieved and thus claim 3 is patentable over *Khor I*.

Applicants point out further that due to properties, such as a miscibility gap, inherent in hydroxyapatite and zirconia this “nano-alloying” *cannot* be achieved through other types of spraying of solid or liquid precursors or through equilibrium processing, i.e., conventional heat treatment. In DC plasma spraying used in *Khor I*, resident times in the plasma are very low thus only allowing the physical mixing to occur. The RF plasma spraying process used is conceptually different and superior to other thermal plasmas in this respect as it is firstly a relatively low temperature process, while DC plasmas are of about 15-25,000 °C. The RF plasma spraying of the claimed invention further introduces a larger volume plasma, enables relatively higher resident time, and allows for a more wholesome treatment of the injected particles, while allowing easy mixing of the feedstock.

Applicants note that an advantage of the RF Plasma Spraying Process of embodiments of the claimed invention is finer control on particle size, microstructure and morphology as indicated in Figure 1 to Figure 3, and described in paragraphs [0022] to [0030] of Applicants' Specification, for example. Another advantage of embodiments of the claimed invention is that the particles obtained using the method of the claimed invention show advantageous mechanical properties when compared to conventionally obtained powders. The product of the method of the invention is superior to conventional powders in terms of the Young's modulus, which is also known as the modulus of elasticity or the tensile modulus and indicates the elastic properties of a solid undergoing tension or compression in only one direction. Furthermore, as Table 3 and paragraph [0032] to [0030] of Applicants' Specification describe the product of the method of the invention is also superior to conventional powders in terms of fracture toughness and hardness.

*Karthikeyan* suffers from the same unpredictability of results that *Khor I* does because of the use of the conventional plasma spraying system. *Karthikeyan* appears to disclose the formation of fine particles of either alumina, zirconia or yttria stabilized zirconia. Similar to *Khor I*, conventional plasma spraying is used in *Karthikeyan* (abstract, first phrase) rather than RF Plasma Spraying. The DC plasma spraying process is modified in *Karthikeyan* by omitting a reaction chamber and termed plasma spray synthesis. This process is clearly distinguished from RF plasma spraying in *Karthikeyan* (left col., first para, lines 8 to 14).

Further, Figure 1 of *Karthikeyan* (top of page 276 thereof) is a schematic depicting an anode and a cathode, which is typical for a DC plasma system. An RF system, being an induction-coupled plasma, does not have electrodes. In this regard, the plasma spray torch used in *Karthikeyan* is a Miller Thermal SG 100 (page 276, right col., last line), which is a DC plasma torch. This fact can be taken from the attached manufacturer's brochure (see e.g. the figure at the bottom of page 7 under "Model SG-100 Gun" or the legend on the bottom of page 9 under "Net Energy"). Likewise, the operation parameters depicted in Table 1 on page 278 of *Karthikeyan* include values of an Arc current (A) and voltage (V) of a direct current, thereby indicating a DC plasma spraying system. In addition, *Karthikeyan* does not suggest to the skilled reader to use an

RF Plasma Spraying Process, neither does it motivate him to attempt doing so. Accordingly, combining *Khor I* and *Karthikeyan* cannot render the method of the invention obvious

*Khor II* suffers from the same unpredictability of results that *Khor I* and *Karthikeyan* do because of the use of the conventional plasma spraying system. *Khor II* appears to be directed to the coating of titanium with hydroxyapatite that contains yttria stabilized zirconia. Again, DC plasma spraying is used, as can be taken from page 161, right column, 2<sup>nd</sup> paragraph, lines 3 et seq. of *Khor II*. Furthermore, *Khor II* cites references (16-18) on page 165, left col, 2<sup>nd</sup> paragraph, with regard to coatings obtained by plasma spraying that refer to DC plasma systems. In *Khor II* a solid feedstock is used instead of the liquid feedstock of *Khor I*, while two similar DC plasmas are examined. Since *Khor II* does not mention the possibility of using an RF Plasma Spraying Process, a person of ordinary skill would not predict that using the processes disclosed in *Khor II* would predictably result in claim 3.

In contrast to the combination of *Khor I* and *Karthikeyan* and *Khor II*, the present inventors observed that the RF plasma (T~6000-8000 °C) processing route with its large plasma volume produces **chemically** nano-alloyed nano-composite particles of hydroxyapatite and zirconia rather than physically mixed coatings, as indicated in paragraph [0029] of Applicants' Specification. Using the method of the claimed invention a product is formed that has no clear interface between hydroxyapatite and zirconia phases, as depicted in, e.g., Figure 2 of the present application. Rather, the particles/powders incorporate the secondary additions (ZrO<sub>2</sub>) within the matrix of hydroxyapatite, as pointed out in paragraphs [0025] to [0028] and [0033] of Applicants' Specification.

Applicants respectfully submit that as discussed above, alloyed particles according to the claimed invention cannot be obtained by the methods used in the state of the art due to the inherent properties of the individual materials and the processes used. Accordingly, *Khor I* and *Karthikeyan* and *Khor II* do not and cannot suggest to the skilled artisan that a nano-composite powder of alloyed particles could be formed that include hydroxyapatite, calcium phosphate and zirconium oxide, as defined in claim 3, and there is no predictability that such alloyed particles could be formed. Furthermore, there is no mention in the cited references on particles that (i) include hydroxyapatite and zirconium oxide, and (ii) are of nano-size. *Khor I* relates to the

coating of titanium particles, which have a size of 75 - 106  $\mu\text{m}$  (page 223, right column, lines 3 & 4 of *Khor I*). *Khor II* discloses coatings on stainless steel (page 276, right col., 2<sup>nd</sup> line of *Karthikeyan*) that include either particles of zirconia of 20 - 80 nm (page 279, left col., last line of *Karthikeyan*), of yttria stabilized zirconia of 20 - 100 nm (ibid, right col., first para under “Yttria stabilized zirconia (YSZ)”, 7<sup>th</sup> line) or particles of alumina of 10 - 50 nm (page 278, right col., first para under “Alumina”, 5<sup>th</sup> line). *Khor II* discloses the coating of hydroxyapatite particles of a size of about 0.5 to 50  $\mu\text{m}$  (Fig. 1 of *Khor II*) with yttria stabilized zirconia. Accordingly, none of the cited references provides any indication or suggestion that nano-sized particles of hydroxyapatite, calcium phosphate and zirconium oxide could be formed. Therefore the subject matter of claim 3 is not obvious in the view of the cited references, both taken alone and in combination. The same therefore applies to dependent claim 4.

Because the processes disclosed in *Khor I*, *Karthikeyan*, and *Khor II* would not predictably result in claim 3, the combination of in *Khor I*, *Karthikeyan*, and *Khor II* cannot render the subject matter of claim 3 obvious. Claim 3 is thus patentable over the combination of *Khor I*, *Karthikeyan*, and *Khor II*. Applicants respectfully request therefore that the Examiner reconsider and remove the rejection to claim 3.

Claim 2 properly depends from claim 1 and is thus patentable for at least the same reasons that claim 1 is patentable. (MPEP §2143.03 (citing *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988)).

Applicants have added new claims 4 and 5. Support for new claim 4 according to at least one embodiment can be found in Applicants' Specification at paragraph [0024]. Support for new claim 5 according to at least one embodiment can be found in Applicants' Specification at paragraphs [0021], [0023], and [0033].

## CONCLUSION

Applicants respectfully submit that all grounds for rejection have been properly traversed, accommodated, or rendered moot and that the application is now in condition for allowance. The Examiner is invited to telephone the undersigned representative if the Examiner believes that an interview might be useful for any reason.

Respectfully submitted,

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